

U.S. 5,122,339; Pickens et al. U.S. 5,211,910; Pickens et al. U.S. 5,259,897; Uno et al. JP 01025954; Tack et al. WO 9532074; Witters et al. WO 9212269; Sperry et al. DE 2810932; Langen et al. U.S. 5,462,712; Rioja et al. U.S. 5,137,686; Rioja et al U.S. 4,869,870; Rioja et al. U.S. 4,832,910; Sawtell et al. U.S. 4,648,916; Cho U.S. 4,806,174; Young et al. U.S. 4,790,884; and Rioja U.S. 5,076,859. According to the Examiner, the cited references disclose alloy compositions which overlap the claimed alloy compositions.

Amended Claim 1 recites an aluminum alloy consisting essentially of specific ranges of Cu, Mg and Li which are present in the aluminum alloy in the form of a solid solution. As discussed beginning at page 5, line 26 of the specification, the amounts of Cu, Mg and Li are controlled such that each element does not exceed its maximum solubility in the alloy, thereby maximizing the fracture toughness and damage tolerance of the alloy. Amended Claim 1 further recites that the amount of Cu must be less than or equal to $(-3/5.4)(\text{Mg}-6)+1.5$. In accordance with the claimed invention, the interaction of Li in solid solution with the atoms of Mg and/or Cu appear to give rise to the formation of clusters of atoms of solute. This behavior, which was not expected and is surprising, is apparently responsible for the improved fatigue performance of the alloys of the invention. As discussed at page 7, lines 1-22, by controlling the amounts of Cu, Mg and Li such that the atoms of these metals are amounts to be soluble in the alloy, the atoms of the alloying elements in solid solution form clusters which translate to increased fatigue crack growth resistance. The improved fatigue crack growth resistance achieved by the presently claimed alloys is described in the specification at page 11, line 33 to page 12, line 29, and demonstrated in Figs. 3-7.

Although the cited references disclose many different broad ranges of alloying additions which can be included in aluminum alloys, Applicants have found no teaching or suggestion of: providing an aluminum alloy consisting essentially of the amounts of Cu, Mg and Li within the specific ranges recited in Claim 1; controlling the respective amounts of copper and magnesium to correspond to the formula $\text{Cu} \leq (-3/5.4)(\text{Mg}-6)+1.5$; and further ensuring that each element does not exceed its maximum solubility in the alloy. This combination of features produces an alloy which exhibits increased fatigue crack growth resistance. It is therefore submitted that the aluminum alloy recited in Claim 1 provides

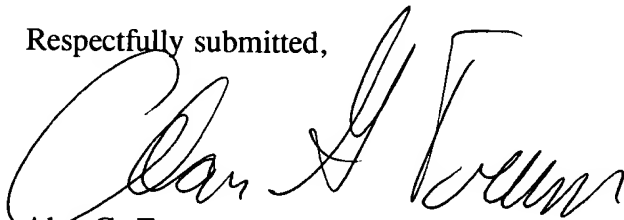
unexpectedly improved results in comparison with known alloy compositions and is patentable over the prior art of record.

Amended Claim 12 similarly recites an aluminum alloy consisting essentially of specific boundaries of Cu, Mg and Li alloying additions which have been found to provide improved mechanical properties. As recited in Claim 12, the amount of Cu ranges from about 3 to 4.5 weight percent, the amount of Mg ranges from about 1.0 to 2 weight percent, and the amount of Li ranges from about 0.01 to 99 weight percent. Furthermore, the combined amount of Cu and Mg must be below the line running from Point B to Point G in Fig. 1A. By controlling the amounts of Cu, Mg and Li within narrowly defined boundaries, and by further controlling the combined amounts of Cu and Mg as recited in Claim 12, Applicants have produced an aluminum alloy with unexpectedly improved fatigue crack growth resistance properties. It is therefore submitted that the aluminum alloy recited in Claim 12 provides unexpectedly improved results in comparison with known alloy compositions and is patentable over the prior art of record.

In view of the foregoing amendments and remarks, it is submitted that Claims 1-8, 12, 16-22, 26 and 27 are patentable over the prior art of record. Accordingly, an early notice of allowance of this application is respectfully requested.

In the event that any outstanding matters remain in connection with this application, the Examiner is invited to telephone the undersigned at (412) 566-6109 to discuss such matters.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Alan G. Towner", is written over the typed name.

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Marked-Up Version of Amended Claims 1 and 12

1. (Twice amended) An aluminum alloy [comprising] consisting essentially of from about 3 to about 4.5 wt % copper, from about [0.6] 1.0 to about 2 wt % magnesium and from about 0.01 to about 0.99 wt % lithium, wherein the copper, magnesium and lithium are present in the aluminum alloy in the form of a solid solution, and the amounts of copper and magnesium correspond to the formula $Cu \leq (-3/5.4) (Mg-6) + 1.5$.

12. An aluminum alloy [comprising] consisting essentially of copper, magnesium and lithium, the lithium content being from about 0.01 to 0.99 wt % and the copper and magnesium weight percent values falling within a closed area on a graph with wt % copper on the x-axis and wt % magnesium on the y-axis, said closed area being bounded by generally straight lines joining the following points:

POINT 1 = 3 Cu, [0.6] 1.0 Mg

POINT 2 = [4.5] 4.28 Cu, [0.6] 1.0 Mg

POINT 3 = 3.7 Cu, 2 Mg

POINT 4 = 3 Cu, 2 Mg

and back to POINT 1.

Newly Added Claims

26. The aluminum alloy of Claim 1, wherein said lithium content comprises a maximum of 0.8 wt %.

27. The aluminum alloy of Claim 2, wherein said lithium content comprises a maximum of 0.8 wt %.